Experiment: Common Gate Amplifier

Aim:

To implement a common gate amplifier of gain 10 and analyze its transient and ac characteristics.

Tool Used:

LTspice

Theory:

The common-gate (CG) amplifier for MOSFET is the analogue of the common base amplifier for BJT. Its popularity arises from its lower noise and ease of impedance matching.

For a Level 3 NMOS let's assume

V_{GS} = 0.6V

V_T = 0.4V

V_{DD} = 1.8V

K_n = 120µA/V^2 ,

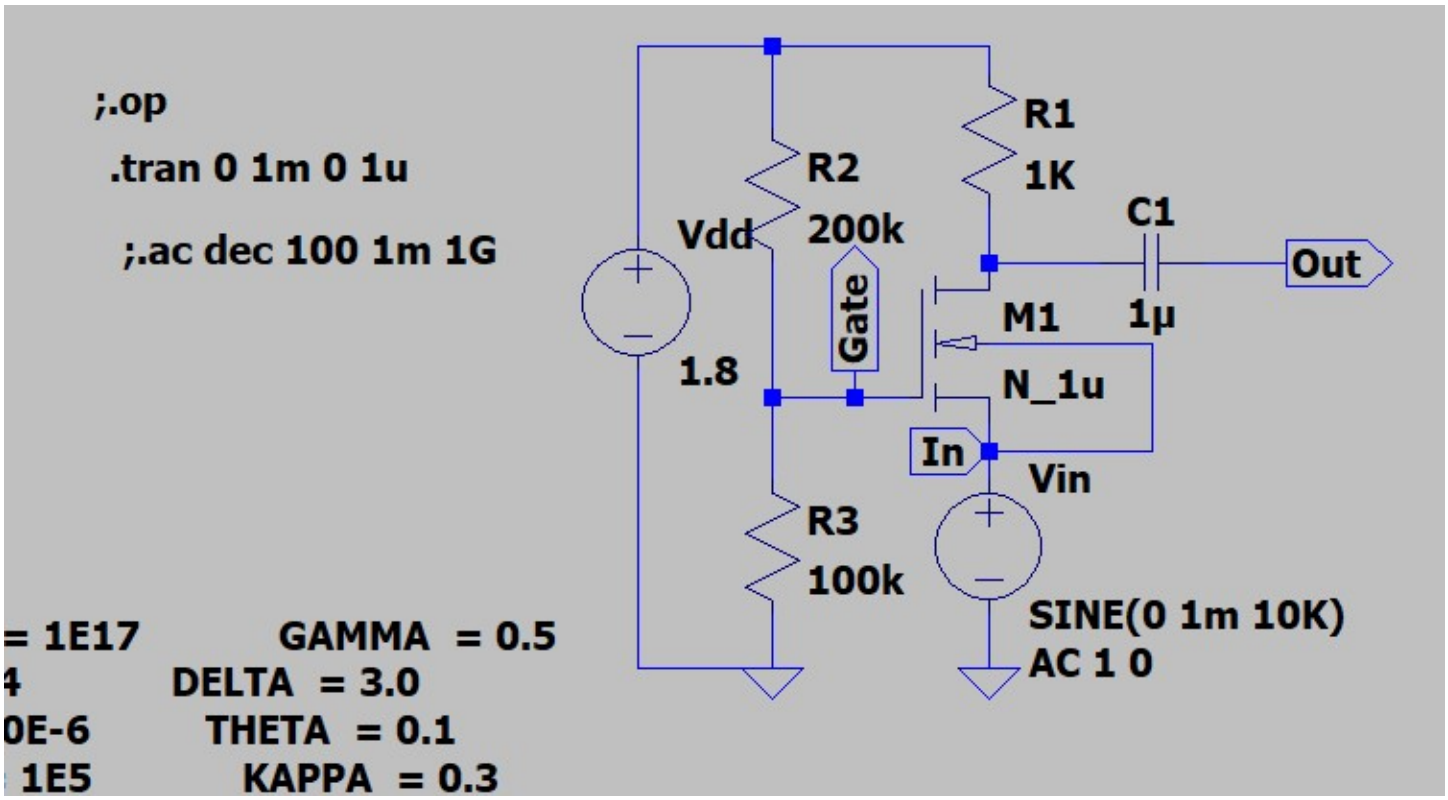
Which gives a value of (W/L) = 416 for 1mA I_D.

Also, for these values g_m is attained as 10mΩ^{-1}, therefore for gain 10, R_D is taken as 1KΩ.

The value of V_{DS} should be maintained above (V_{GS} - V_T = 0.6 - 0.4 = 0.2V) for the transistor to stay in saturation region.

As W/L is 416, the width is taken as 416µm and the length is taken as 1µm.

Circuit Schematic:



Output Waveforms:

DC operating Point

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        --- Operating Point ---

V(n002):        0.351845        voltage
V(gate):        0.6             voltage
V(in):          0               voltage
V(n001):        1.8             voltage
V(out):         3.51845e-007    voltage
Id(M1):         0.00144818      device_current
Ig(M1):         0               device_current
Ib(M1):         -3.61845e-013   device_current
Is(M1):         -0.00144818     device_current
I(C1):          -3.51845e-019   device_current
I(R3):          6e-006          device_current
I(R2):          6e-006          device_current
I(R1):          0.00144815      device_current
I(Vdd):         -0.00145415     device_current
I(Vin):         0.00144815      device_current
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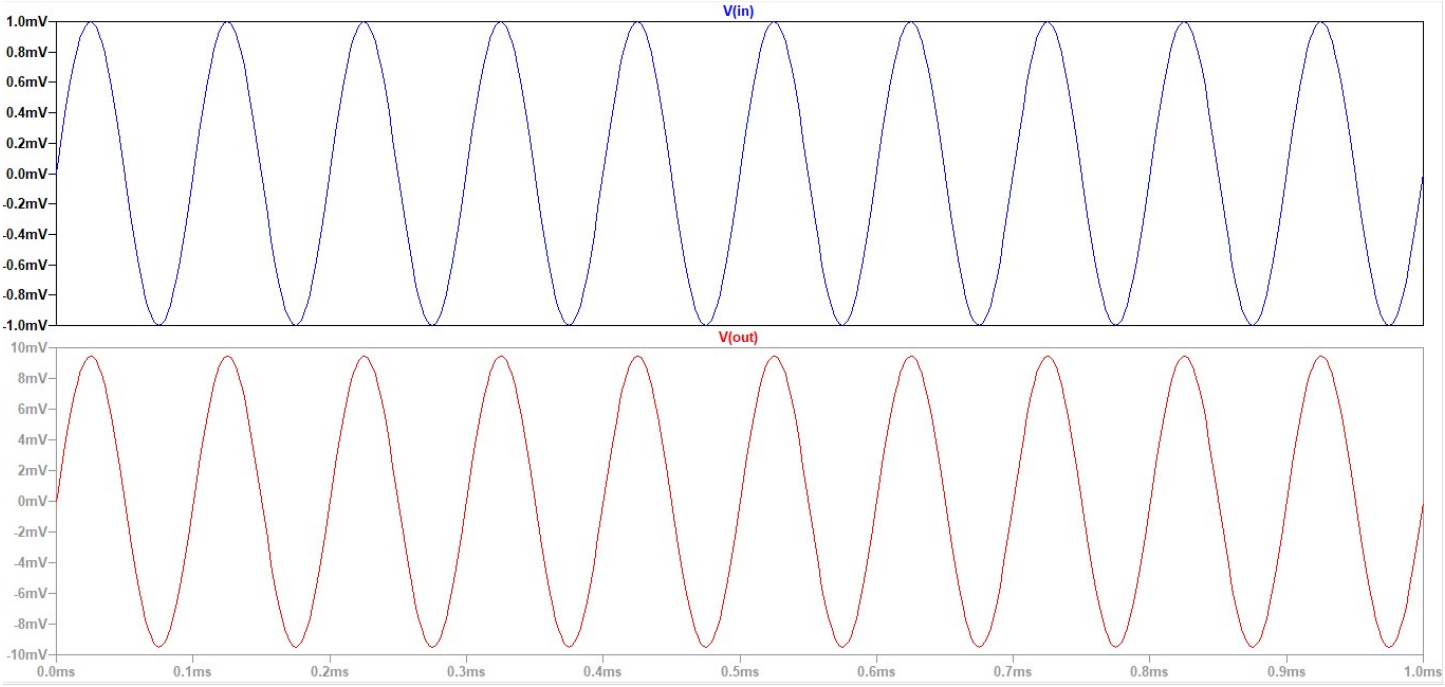
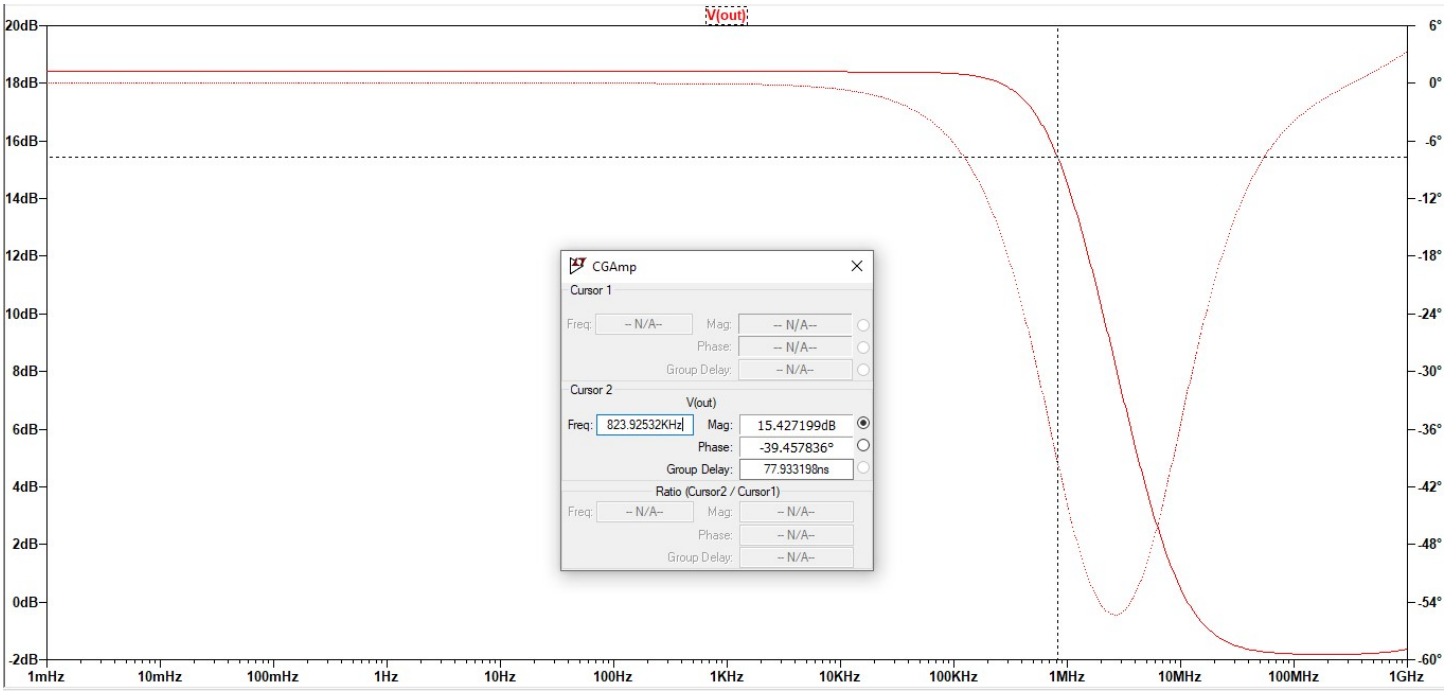
Transient characteristics



AC Analysis



Result:

The circuit is designed for a gain of 10 and the output is verified to be correct. The transient and AC characteristics are visualized.

Bandwidth, F_C = 823KHz.